MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

DCA5068 – FIELD THEORY

(Diploma in Electronic Engineering)

27 MAY 2019
9.00 a.m – 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **3** pages (excluding cover page and appendix)
2. Answer **ALL** questions. All necessary working steps must be shown.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [25 MARKS]

a) Transform the following vector to cylindrical coordinates at the point given:

$$2\hat{j} \text{ at } B(x = 2,\ y = 12,\ z = 3)$$ [13 marks]

b) Calculate the area of the triangle where the vertices are at the points A (1, 1, 3), B (2, −1, 5) and C (−3, 3, 1).

[6 marks]

c) Fill in Table 1 given below for similarity between electric and magnetic circuit.

Magnetic circuit	Electric circuit
Flux = mmf/reluctance	
MMF (AT)	
F - Weber (flux)	
Flux density B	
Reluctance $=l/A$	
Permeance = 1/reluctance	

Table 1

[6 marks]

Continued...

QUESTION 2 [25 MARKS]

a) Referring to Figure 2, calculate the total force on the charge placed at (2,3).

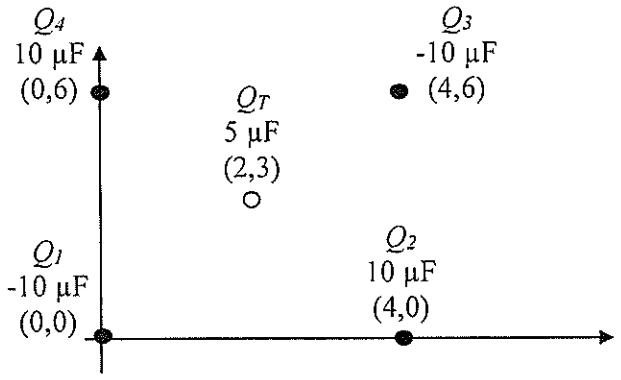

Figure 2

[17 marks]

b) There are three capacitors with the value of 24 μF each, are connected as in Figure 3, calculate:

i) the total capacitance of the combination, [3 marks]

ii) the charge stored on each of the capacitor, [2 marks]

iii) the potential difference across each capacitor. [3 marks]

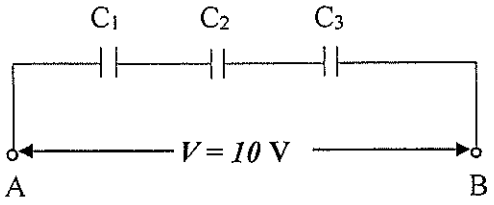

Figure 3

Continued...

QUESTION 3 [25 MARKS]

a) A wire of length 150 cm carrying an electric current of 0.1 A in the negative x direction and perpendicular to a magnetic field B, experiences a force of 6.0×10^{-3} N in the positive y direction due to a magnetic field.

i) Calculate the magnitude of the magnetic field.

[3 marks]

ii) Draw the direction of the magnetic field.

[3 marks]

b) Calculate the magnitude of the induced emf when a magnet is thrust into the coil, given the following information: the single loop coil has a radius of 6 cm and the magnetic field increases from 0.05 T to 0.25 T in 0.1 s.

[8 marks]

c) Two parallel wires are carrying currents of 10 A and 20 A in the same direction. The distance between the two wires is 10 cm which having a length of 1 m each. Calculate the magnitude and draw the direction of the magnetic force.

[11 marks]

QUESTION 4 [25 MARKS]

a) A voltage of 300 V is applied to the primary winding of a voltage transformer that has 1500 turns and draws a current of 20 A. Given the required output voltage from the transformer is 20 V. Assuming an ideal transformer, determine the following:

i) type of transformer and its definition. [4 marks]

ii) turns ratio of the transformer. [3 marks]

iii) secondary number of turns. [3 marks]

iv) secondary current. [3 marks]

b) Draw **three** variations in hysteresis loop and provide **two** characteristics of each loop.

[12 marks]

End of Page.

FORMULAE

Transformation	Coordinate Variables	Unit Vectors	Vector Components
Cartesian to Cylindrical	$r = \sqrt{x^2 + y^2}$ $\phi = \tan^{-1}(y/x)$ $z = z$	$\hat{r} = \hat{x}\cos\phi + \hat{y}\sin\phi$ $\hat{\phi} = -\hat{x}\sin\phi + \hat{y}\cos\phi$ $\hat{z} = \hat{z}$	$A_r = A_x\cos\phi + A_y\sin\phi$ $A_\phi = -A_x\sin\phi + A_y\cos\phi$ $A_z = A_z$
Cylindrical to Cartesian	$x = r\cos\phi$ $y = r\sin\phi$ $z = z$	$\hat{x} = \hat{r}\cos\phi - \hat{\phi}\sin\phi$ $\hat{y} = \hat{r}\sin\phi + \hat{\phi}\cos\phi$ $\hat{z} = \hat{z}$	$A_x = A_r\cos\phi - A_\phi\sin\phi$ $A_y = A_r\sin\phi + A_\phi\cos\phi$ $A_z = A_z$
Cartesian to Spherical	$R = \sqrt{x^2 + y^2 + z^2}$ $\theta = \tan^{-1}(\sqrt{x^2 + y^2}/z)$ $\phi = \tan^{-1}(y/x)$	$\hat{R} = \hat{x}\sin\theta\cos\phi + \hat{y}\sin\theta\sin\phi + \hat{z}\cos\theta$ $\hat{\theta} = \hat{x}\cos\theta\cos\phi + \hat{y}\cos\theta\sin\phi - \hat{z}\sin\theta$ $\hat{\phi} = -\hat{x}\sin\phi + \hat{y}\cos\phi$	$A_R = A_x\sin\theta\cos\phi + A_y\sin\theta\sin\phi + A_z\cos\theta$ $A_\theta = A_x\cos\theta\cos\phi + A_y\cos\theta\sin\phi - A_z\sin\theta$ $A_\phi = -A_x\sin\phi + A_y\cos\phi$
Spherical to Cartesian	$x = R\sin\theta\cos\phi$ $y = R\sin\theta\sin\phi$ $z = R\cos\theta$	$\hat{x} = \hat{R}\sin\theta\cos\phi + \hat{\theta}\cos\theta\cos\phi - \hat{\phi}\sin\phi$ $\hat{y} = \hat{R}\sin\theta\sin\phi + \hat{\theta}\cos\theta\sin\phi + \hat{\phi}\cos\phi$ $\hat{z} = \hat{R}\cos\theta - \hat{\theta}\sin\theta$	$A_x = A_R\sin\theta\cos\phi + A_\theta\cos\theta\cos\phi - A_\phi\sin\phi$ $A_y = A_R\sin\theta\sin\phi + A_\theta\cos\theta\sin\phi + A_\phi\cos\phi$ $A_z = A_R\cos\theta - A_\theta\sin\theta$
Cylindrical to Spherical	$R = \sqrt{r^2 + z^2}$ $\theta = \tan^{-1}(r/z)$ $\phi = \phi$	$\hat{R} = \hat{r}\sin\theta + \hat{z}\cos\theta$ $\hat{\theta} = \hat{r}\cos\theta - \hat{z}\sin\theta$ $\hat{\phi} = \hat{\phi}$	$A_R = A_r\sin\theta + A_z\cos\theta$ $A_\theta = A_r\cos\theta - A_z\sin\theta$ $A_\phi = A_\phi$
Spherical to Cylindrical	$r = R\sin\theta$ $\phi = \phi$ $z = R\cos\theta$	$\hat{r} = \hat{R}\sin\theta + \hat{\theta}\cos\theta$ $\hat{\phi} = \hat{\phi}$ $\hat{z} = \hat{R}\cos\theta - \hat{\theta}\sin\theta$	$A_r = A_R\sin\theta + A_\theta\cos\theta$ $A_\phi = A_\phi$ $A_z = A_R\cos\theta - A_\theta\sin\theta$

Permittivity of free space, $\varepsilon_o = 8.854\times10^{-12}\,F/m$

Permeability of free space, $\mu_o = 4\pi\times10^{-7}\,T.m/A$